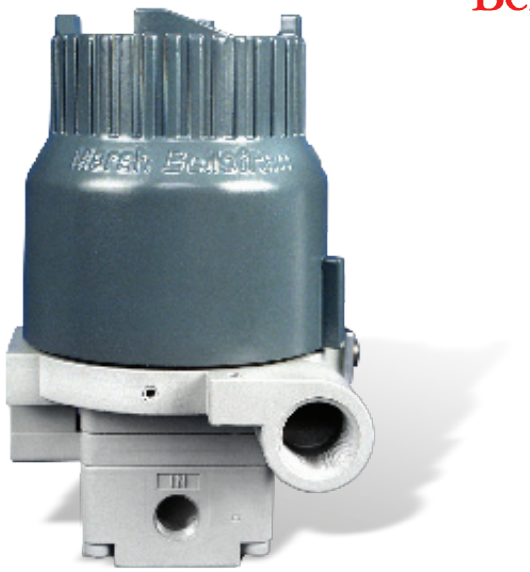
T2000 Explosion Proof I/P & E/P Transducers

- Field-selectable inputs and direct/reverse/split ranging
- Multiple input/output/mounting configurations
- Precise, reliable performance under extreme conditions of temperature, vibration, orientation, supply pressure changes, supply voltage changes, RFI/EMI, humid/oil-laden media, and corrosive surroundings



The T2000EX is a robust electronic instrument that regulates an incoming supply pressure down to a precise output pressure which is directly proportional to an electrical control signal. The secret to the T2000EX's precise, reliable performance under a variety of demanding environmental conditions is a patented piezo-ceramic actuator with many industry-wide firsts.

Applications

- Valve Actuators
- Valve Positioners
- Relay
- Controllers
- Chemical & Petrochemical Industries
- Petroleum Production
- Pipeline Transmission

Principle of Operation

The T2000EX I/P and E/P transducers utilize closed-loop pressure feedback-control for precision pressure output and minimized effects of temperature, supply pressure changes, supply voltage changes, and mounting angle.

Supply pressure is reduced by the supply valve to provide an output pressure which is internally routed to a precision temperature compensated piezo resistive pressure sensor. Supply pressure is also routed to an externally removable orifice which provides a reduced pilot pressure to a chamber containing a servo diaphragm and nozzle. Pilot pressure is controlled by modulating the gap between the face of a nozzle and an adjacent piezo-ceramic actuator, which is part of a unique patented mechanism.

The piezo-ceramic actuator serves as a control link between electrical input and pressure output as follows:

- The input current (I/P) or voltage (E/P) signal is conditioned to provide a normalized control signal directly proportional to the desired pressure output.
- Simultaneously the output of the pressure sensor is amplified and conditioned to produce a feedback signal.
- The sum of the control signal and the feedback signal produce a command signal which is delivered as a DC voltage to the piezo-ceramic actuator.
- As voltage increases, the force applied by the actuator increases, so as to restrict nozzle bleed and thus increase pilot pressure.
- Increased pilot pressure applied to the servo diaphragm directly causes opening of the supply valve and an increase in the output pressure until the output feedback signal and control signal combine to produce the correct command signal.

Air Quality

Instrument-quality air consists of
a. A dew point less than 35˚F
b. No particles larger than three microns
c. Maximum oil content of 1 ppm

Fine-Tuning Your Application

For optimal performance in your application, the calibration of the Type 2000EX can be fine-tuned in the field. An easily-removable cover provides access to the isolated electronics. All potentiometers, connections, jumpers, and switches are clearly marked on the circuit board or on the handy chart located on the inside of the cover. The three elements of calibration (Gain, Zero, and Span) are described below. Consult the T2000EX User's Manual for detailed calibration procedures, cautions, and instrumentation requirements.

Gain (Damping) Adjustment

The output response of the T2000EX can be optimized for varying downstream volumes by adjusting the system gain of the control circuit. Adjust the Gain Pot counterclockwise for increased gain; clockwise for increased oscillation damping. For maximum allowable gain in your application, the pot should be turned clockwise until oscillation just disappears.

Zero & Span Adjustments

The T2000EX contains multi-turn Coarse-Zero, Fine-Zero, and Span adjustment potentiometers which are clockwise positive. Adjustment of either Zero Pot changes the unit's minimum output while the Span Pot changes the maximum output. The adjustments are interactive, so it may take iterations to reach the desired calibration.

Wide Rangeability

The T2000EX can be field calibrated to pressure ranges other than the standard ones by combinations of recalibration, pressure range switching, and split high/low ranging. A unit should not be switched to a range outside its pressure sensor family (eg., 0-15 PSIG can be switched to a 3-15 PSIG, but not to 0-30 PSIG). (Caution: Do not exceed the range of the onboard pressure sensor.) For example, the easiest way to recalibrate a 0-30 PSIG unit to 3-15 PSIG would be to change the switch setting to 3-27 PSIG, then switch to split range low.

Field-Selectable Features

Onboard switches allow the user to easily reconfigure the T2000EX for any of several electrical inputs, direct/reverse acting, or output split-ranging high/low. Fine tuning of the unit's calibration may be necessary after a reconfiguration.

Direct/Reverse Acting

Direct Acting transducers regulate to their minimum output when supplied with minimum input; maximum out with maximum in. Reverse Acting transducers regulate to their maximum output at minimum input.

Split Ranging–High & Low

The T2000EX can be configured to regulate either half (top or bottom) of it's normal output range, when supplied with it's normal full-ranging electrical input. For example, a 0-10V 0-30 PSIG unit set to split range low will regulate 0-15 PSIG @ 0-10V. It will regulate 15-30 PSIG @ 0-10V if set to split range high.

Hazardous Area & Usage Classification

"F" model: Dual Listing of FM/CSA for following approvals:

Explosion Proof: Class I, Division 1, Groups A,B,C,D, T6 @ 60°C Max

Dust Ignition Proof: Class II, III, Division 1, Groups E,F,G; T6 @ 60°C Max

Intrinsic Safety: FM/CSA Class I II III, Division 1, Groups A,B,C,D,E,F,G, T4 @ 60°C Max

Non-incendive: Class I, Division 2, Groups A, B, C, D. T4 @ 60°C Max

Suitable for use in Class II III, Division 2, Groups F, G. T4 @ 60°C Max

Environmental rating: TYPE 4X, IP66

Note: Certified by FM, "F" model can be used in Natural Gas application in US and Canada, merely in a condition that a suitably rated NRTL listed or certified conduit seal is mandatory.

"G" model: Listing of FM for using Natural Gas as a process medium in US and Canada for following approvals:

Explosion Proof: Class I, Division 1, Groups A,B,C,D, T6 @ 60°C Max

Dust Ignition Proof: Class II, III, Division 1, Groups E,F,G; T6 @ 60°C Max

Intrinsic Safety: FM Class I II III, Division 1, Groups A,B,C,D,E,F,G T4 @ 60°C Max

Non-incendive: Class I, Division 2, Groups A, B, C, D. T4 @ 60°C Max

Suitable for use in Class II III, Division 2, Groups F, G. T4 @ 60°C Max

Environmental rating: TYPE 4X, IP66

Note: "G" model includes a factory conduit seal. No additional NRTL certified seal is required for Natural Gas application.

CE: (Conduit Connector Only) EN 50081-1 Residential, commercial & light industry; EN-50082-2 Heavy Industrial.

T2000 Part Matrix

2K	E						1		00		
										Electrical Port	
		N								1/2 NPT Conduit	
										Pneumatic Ports	
			N							NPT	
			T							BSPT	
			P							BSPP	
			M							Manifold Mount*	*Bottom O-Ring Ports
										Agency Approval	
				F						FM/CSA	
				G						FM Natural Gas Approval for US and Canada, includes factory conduit seal	
										Electrical Input	
					42					4-20 mA	
					05					0-5 V	
					15					1-5 V	
					19					1-9 V	
					11					1-10 V	
					01					0-10 V	
						D				Direct Acting	
						R				Reverse Acting	
										Pneumatic Output	
							F			Full Range	
							H			Split Range High	
							L			Split Range Low	
								1		Pressure Ranges	
										PSIG / BAR	
									005	0-5 / 0-0.3	
									015	0-15 / 0-1.0	
									315	3-15 / 0.2-1.0	
									117	1-17 / 0.07-1.2	Maximum supply for these pressure ranges is 100 psig.
									030	0-30 / 0-2.1	
									630	6-30 / 0.4-2.1	
									327	3-27 / 0.2-1.9	
									060	0-60 / 0-4.1	
									100	0-100 / 0-6.9	Maximum supply for these pressure ranges is 140 psig.
									120	0-120 / 0-8.3	
										Specials	
									00	None	

It is mandatory for the user to install a suitably rated NRTL Listed or Certified conduit seal.

Terminal Block	I/P Transducer	E/P Transducer
S	N/C	+ Signal
+	+ Signal	+ Power Supply
-	- Signal	Common

Type 2000 Wiring Connections and Switch Positions

Switch #	1: psig	BAR	2	3	4	5	6: psig	BAR	7	8	9
ON	0-15 3-15 1-17 0-30 3-27 6-30 0-100	0-1.0 0.2-1.0 0.07-1.2 0-2.1 0.2-1.9 0.4-2.1 0-6.9	1-5 VDC 0-5 VDC	Split Low	Voltage Input (E/P)	Split Low Full	0-15 1-17 0-30 0-60 0-100 0-120	0-1.0 0.07-1.2 0-2.1 0-4.1 0-6.9 0-8.3	Reverse Acting	Full	I/P
Switch #	1: psig	BAR	2	3	4	5	6: psig	BAR	7	8	9
OFF	0-60 0-120	0-4.1 0-8.3	1-9 VDC 0-10 VDC 4-20 mA	Full Split High	Current Input (I/P)	Split High	3-15 3-27 6-30	0.2-1.0 0.2-1.9 0.4-2.1	Direct Acting	Split Low Split High	E/P

Mounting Options

Mounting Method	Explosion-Proof (E) Model
In-Line	Yes
Direct Mounting	Side or Bottom Holes
Panel Bracket	Accessory
Valve Bracket	Supplied
Pipe Bracket	Accessory
DIN-Rail Bracket	Accessory
Manifold Plate	Accessory

Mounting: The Type 2000 can be mounted in-line, or directly to a panel via mounting holes located in the side and bottom of the unit. In addition, the S model includes a panel-mounting bracket; while the E model includes a valve-mounting bracket. Kits are available for mounting of either model to panel, valve, pipe, or DIN-Rail. A custom plate is available for mounting of the bottom-ported version to a manifold. (See Accessories)

Sealing Fittings for FM approved T2000 EX Transducers

Application & Installation
Class I, Divisions 1 & 2

Seals in a Class I hazardous location is to minimize the passage of gases and vapors and prevent the passage of flames from one electrical installation to another through the conduit system. Seals are required to be installed within 18 inches on any conduit run entering an enclosure which contains devices that may produce arcs, sparks or high temperatures.

The T2000 Explosion Proof Transducer is available with the seal fitted to the transducer conduit port or can be supplied as a component to be applied at the installation of the system.

It is mandatory for a suitably rated conduit seal to be installed with the FM approved T2000 EXP Transducer.

Vertical or Horizontal Seals

All seal housings are approx. 3-1/2" in laying length and 1-1/2" OD

Part Number	Description
SF-04AMM	1/2" Aluminum
SF-04AMF	1/2" Aluminum w/nipple
SF-04IMM	1/2" Iron
SF-04IMF	1/2" Iron w/nipple

Sealing Materials

Per seal housing installed, approx. 1/16 oz of packing fiber is used for the dam and 1.5 oz of compound is used for the seal.

Part Number	Description
SC-4	4 oz. Sealing Compound
SC-8	8 oz. Sealing Compound
FP-4	4 oz. Packing Fiber

Larger quantities of fiber and compound available upon request.

Accessories

	Part Number
Panel Mounting Kit	010-135-000
Valve Mounting Kit	010-134-000
2" Pipe Mounting Kit (Valve Mounting Kit is required)	010-143-000
DIN Rail Adapter	010-115-000
Manifold Adapter Kit	971-158-000
Filter Kit, 60 microns	010-139-000
Pressure Gauge Kit 15 psig (1 BAR)	010-138-000
Pressure Gauge Kit 30 psig (2.1 BAR)	010-138-001
Pressure Gauge Kit 60 psig (4.1 BAR)	010-138-002
Pressure Gauge Kit 160 psig (11 BAR)	010-138-003

T2000 Specifications

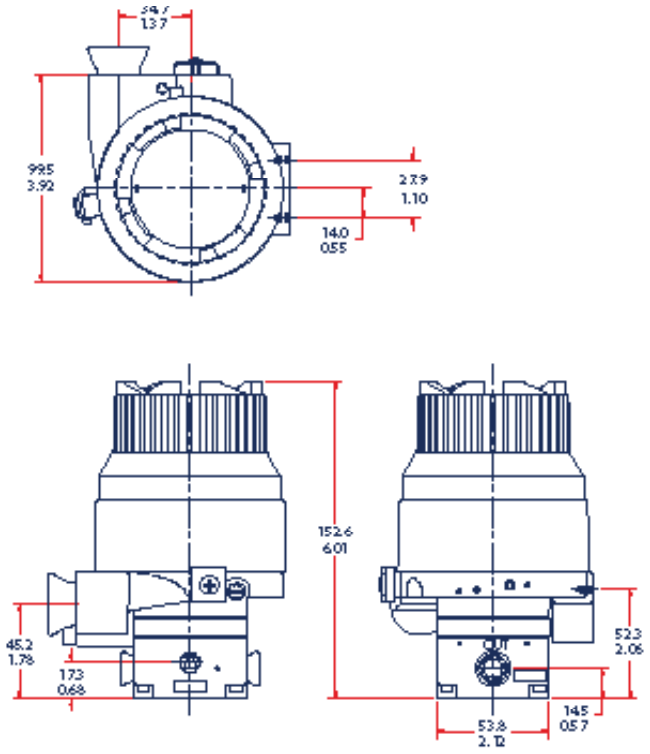
Accuracy	0.1% of full-scale output typical (0.25% guaranteed); includes effects of hysteresis, dead band, and repeatability	
Electrical		
Inputs	Switch-Selectable 4-20mA. 0-5, 1-5, 1-9, 1-10, or 0-10VDC	
Connections	1/2 NPT or 20mm Conduit	
Power Supply	5-28VDC (with voltage inputs only)	
Direct/Reverse Acting	Switch-Selectable	
Pneumatic		
Outputs	PSIG	0-5, 0-15, 3-15, 1-17, 0-30, 6-30, 3-27, 0-60, 0-100, or 120
	BAR	0-0.1, 0-0.3, 0-1.0, 0.2-1.0, 0.07-1.2, 0-2.1, 0.4-2.1, 0.2-1.9, 0-4.1, 0-6.9, 0-8.3
Ports (Input/Output)	1/4 (NPT, BSPT, or BSPP threads) Bottom-ported for Manifold Mounting	
Exhaust	(Explosion proof only) 1/8 - 27 NPT	
Ports (Gauge)	1/8 NPT	
Supply	For 0–5 PSIG (0.3 BAR) Through 0–60 PSIG From 5 PSIG (0.3 BAR) above maximum output to 100 PSIG maximum For 0-100 PSIG and 0–120 PSIG Ranges From 5 PSIG (0.3 BAR) above maximum output to 140 PSIG maximum	
Split-Ranging	Switch-Selectable, Full-Range or Split-Range High or Split-Range Low	
Consumption	4 scfh maximum (1.9 LPM)	

Flow Capacity

Range		Sensor		Flow	
PSIG	BAR	PSIG	BAR	scfm	LPM
0-5	0-0.3	5	0.3	11	312
0-15	0-1.0	15	1.0	15	423
3-15	0.2-1.0	15	1.0	15	423
1-17	0.07-1.2	15	1.0	15	423
0-30	0-2.1	30	2.1	15	423
3-27	0.2-1.9	30	2.1	15	423
6-30	0.4-2.1	30	2.1	15	423
0-60	0-4.1	50	3.5	15	423
(Typical Flow @ 100 PSIG (6.9 BAR) in and maximum out)					
0-100	0-6.9	100	6.9	21	595
0-120	0-8.3	100	6.9	21	595
(Typical Flow @ 140 PSIG (9.7 BAR) in and maximum out)					

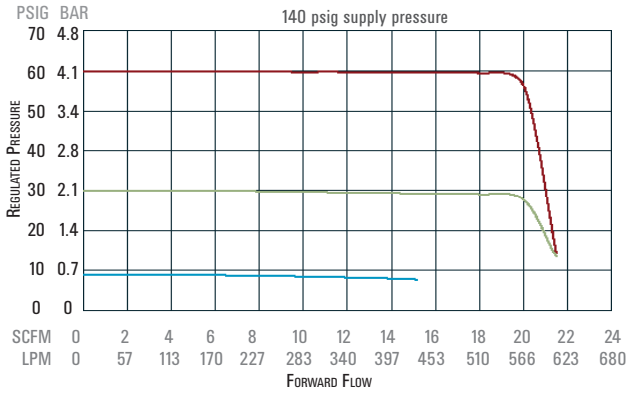
Exhaust Capacity	3 SCFM (85 LPM) @ 5 PSIG (0.3 BAR) above setpoint (0-15 PSIG range unit set at mid range)
Stability	
Supply Voltage Effect	None
Supply Pressure Effect	None
Vibration Effect	< 1% FS (+/-1G; 5-1000Hz)
Mounting Position Effect	None
RFI/EMI	CE-Compliant
Temperature Effect	0.02% FS/°F (-40° to 180°F [-40° to 82°C])
Storage Temperature	-40°to 200°F (-40 to 93°C)
Approximate Weight	3.0 lbs, 1.35 kg

Type 2000 Explosion Proof Dimensions



Drawings and dimensions are for reference only.

REGULATED PRESSURE VS. FLOW



Agency Approvals - Applies only to units ordered with approvals

Factory Mutual
T-2000 I/P & E/P Transducers Explosion Proof / Intrinsically Safe Model
Explosion Proof: Class I, Division 1, Groups A, B, C, & D, T6 Ta = 60°C
Dust-Ignition Proof: Classes II & III, Division 1, Groups E, F, & G , T6 Ta = 60°C; Type 4X **NEMA 4X**, IP66
Intrinsically Safe: Classes I, II, & III, Division 1, Groups A, B, C, D, E, F, & G , T4 Ta = 60°C; Entity; Type 4X **NEMA 4X**, IP66
Non-incendive: Class I, Division 2, Groups A, B, C, & D, T4 Ta = 60°C
Suitable: Class II, Division 2, Groups F & G , T4 Ta = 60°C
Suitable: Class III, Division 2, T4 Ta = 60°C, Type 4X, IP66
Entity Parameters:
Input Option b = 42: V_{Max} = 30 V, I_{Max} = 200 mA, P_{Max} = 1 W, C_i = 0, L_i = 0.
Input Option b = 01, 05, 11, 15 or 19: V_{Max} = 30 V, I_{Max} = 100 mA, P_{Max} = 0.75 W, C_i = 0, L_i = 0.
Special Conditions of Use:
The T-2000 for use with natural gas as a process medium, where a NRTL listed or certified conduit seal or a factory conduit seal is used.

T-2000 E/P or I/P Transducers Intrinsically Safe Model
Intrinsically Safe: Classes I, II, & III, Division 1, Groups A, B, C, D, E, F, & G, T4 Ta = 60°C; Entity;
Non-Incendive: Class I, Division 2, Groups A, B, C, & D, T4 Ta = 60°C
Suitable: Class II, Division 2, Groups F & G, T4 Ta = 60°C
Suitable: Class III, Division 2, T4 Ta = 60°C Type 4X **NEMA 4X**
Entity Parameters:
When Electrical Input Option *c* = 42: V_{Max} = 30 V, I_{Max} = 200 mA, P_{Max} = 1 W, C_i = 0, L_i = 0.
When Electrical Input Option *c* = 05, 15, 19, 11 or 01: V_{Max} = 30 V, I_{Max} = 100 mA, P_{Max} = 0.75 W, C_i = 0, L_i = 0.

T-2000 E/P or I/P Transducers Intrinsically Safe with Terminal Block Model
Intrinsically Safe: Class I, Division 1, Groups A, B, C, & D, T4 Ta = 60°C Entity;
Non-Incendive: Class I, Division 2, Groups A, B, C, & D, T4 Ta = 60°C
Entity Parameters:
When Electrical Input Option c = 42: V_{Max} = 30 V, I_{Max} = 200 mA, P_{Max} = 1 W, C_i = 0, L_i = 0.
When Electrical Input Option c = 05, 15, 19, 11 or 01: V_{Max} = 30 V, I_{Max} = 100 mA, P_{Max} = 0.75 W, C_i = 0, L_i = 0.

Canadian Standards Association - **T-2000 I/P & E/P Transducers**
Hazardous Locations: Class I, Division 1, Groups A, B, C, & D; Class II, Groups E, F & G; Class III.

Explosion Proof I/P & E/P Transducer, Rated: 28Vdc, 8mA;
T-Code T6; Enclosure Type 4X **NEMA 4X**, IP66;
Max Ambient Temperature: +60°C. IN COMPLIANCE WITH STD C22.2 No 213.

T-2000 I/P & E/P Transducers
Intrinsically Safe, Entity - Hazardous Locations: Class I, Divisions 1 & 2, Groups A , B, C, & D; Class II, Division 1, Groups E, F, & G, Division 2, Groups F & G; Class III Hazardous Locations
Electro-Pneumatic I/P and E/P Transducers. Maximum Ambient Temperature: +60°C. Enclosure Type 4X **NEMA 4X**, T4. Intrinsically Safe when installed.
Explosion proof: Class I, Division 1, Groups A, B, C & D; Class II, Groups E, F, & G; Class III. **NEMA 4X**
Rated: 28Vdc, 8mA; T-Code T6; Enclosure Type 4X, IP66; Max Ambient Temperature: +60°C. Intrinsically Safe when installed. Two sets of Entity Parameters may be used in the installation of this product.
Entity Parameters
I/P: V_{Max} = 30V I_{max} = 200mA P_{Max} = 1.0W C_i = 0mF L_i = 0mH
E/P: V_{Max} = 30V I_{Max} = 100mA P_{Max} = 0.75W C_i = 0mF L_i = 0mH

ATEX (EUROPEAN MODEL)
T-2000 I/P & E/P Transducers
INTRINSIC SAFETY: II 1 G EEx ia IIC T4 (-20<Ta<+60) EN 50014:1997 (A2) EN 50020:1994 EN 500284:1999

It is mandatory for the user to install a suitably rated NRTL Listed or Certified conduit seal

The Bellofram T-2000 Transducers were tested and found to comply with Electromagnetic Compatibility Directive effective January 1, 1996. The relevant EMC specifications tested were the following: EN 50081-1 (1992) and EN 50082-1 (1992). A Technical Construction File, Serial #107 was written and Certificate of Conformity issued by a Competent Body.